Zebra and Quagga Mussel Update

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Zebra and Quagga Mussel Update

- Origins and spread through the U.S. and Canada
- Basic Biology
- Means of Control
- Geographic Distribution

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Origins- Lake St. Clair 1988

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Zebra Mussel Distribution 1988

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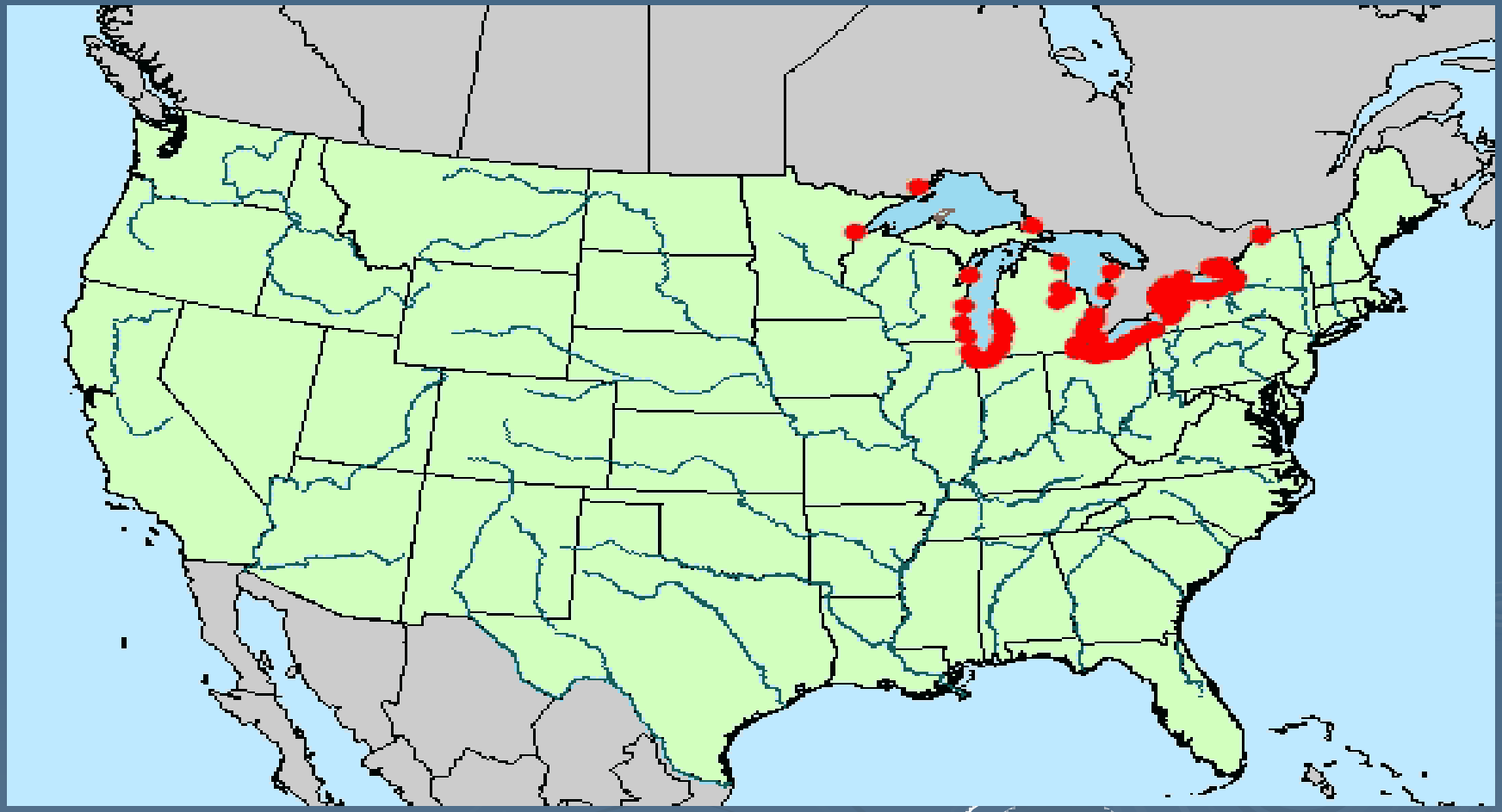
Zebra Mussel Distribution 1990



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Zebra Mussel Distribution 1994

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Zebra Mussel Distribution 1998

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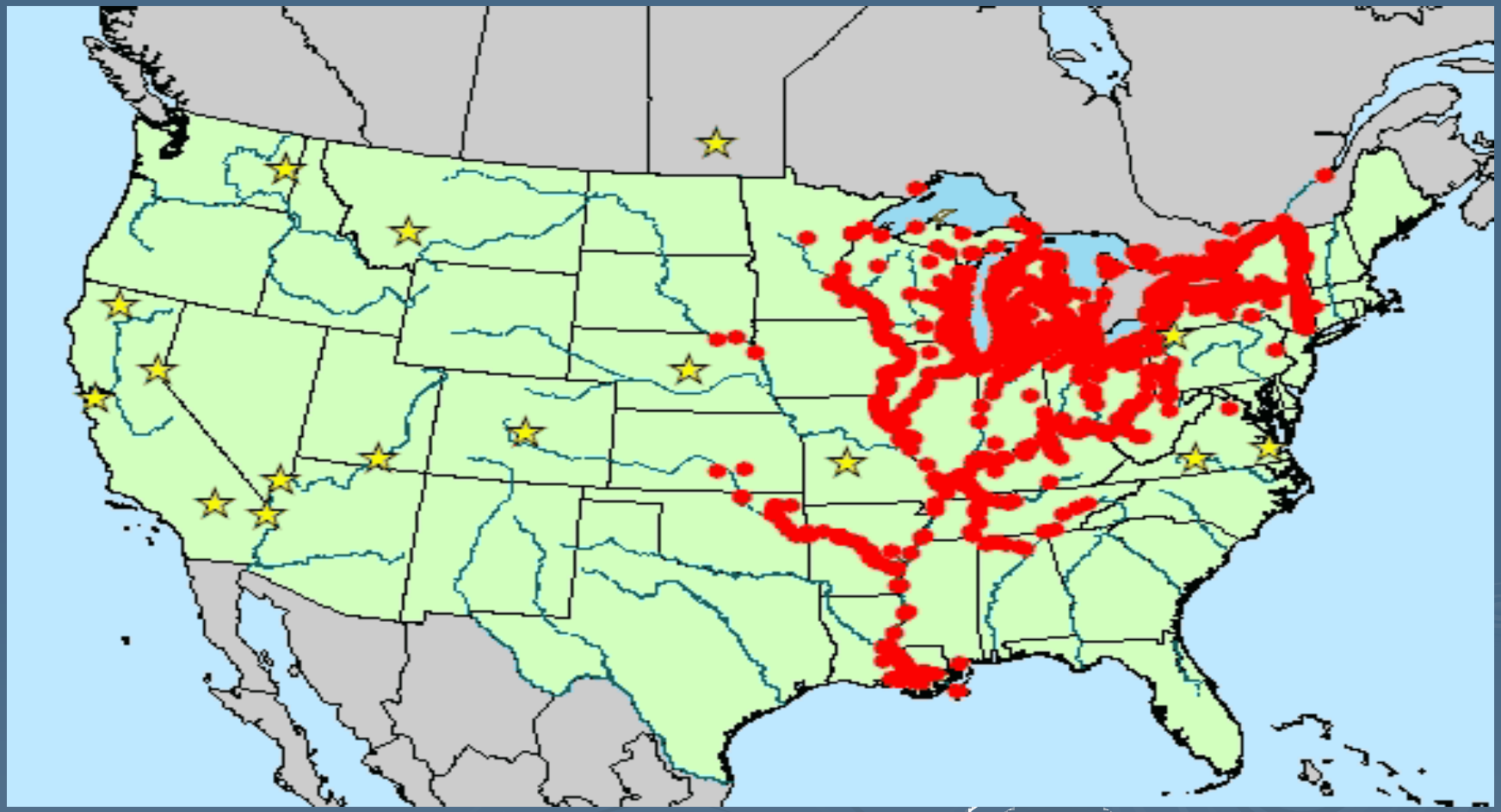
Zebra Mussel Distribution 2004



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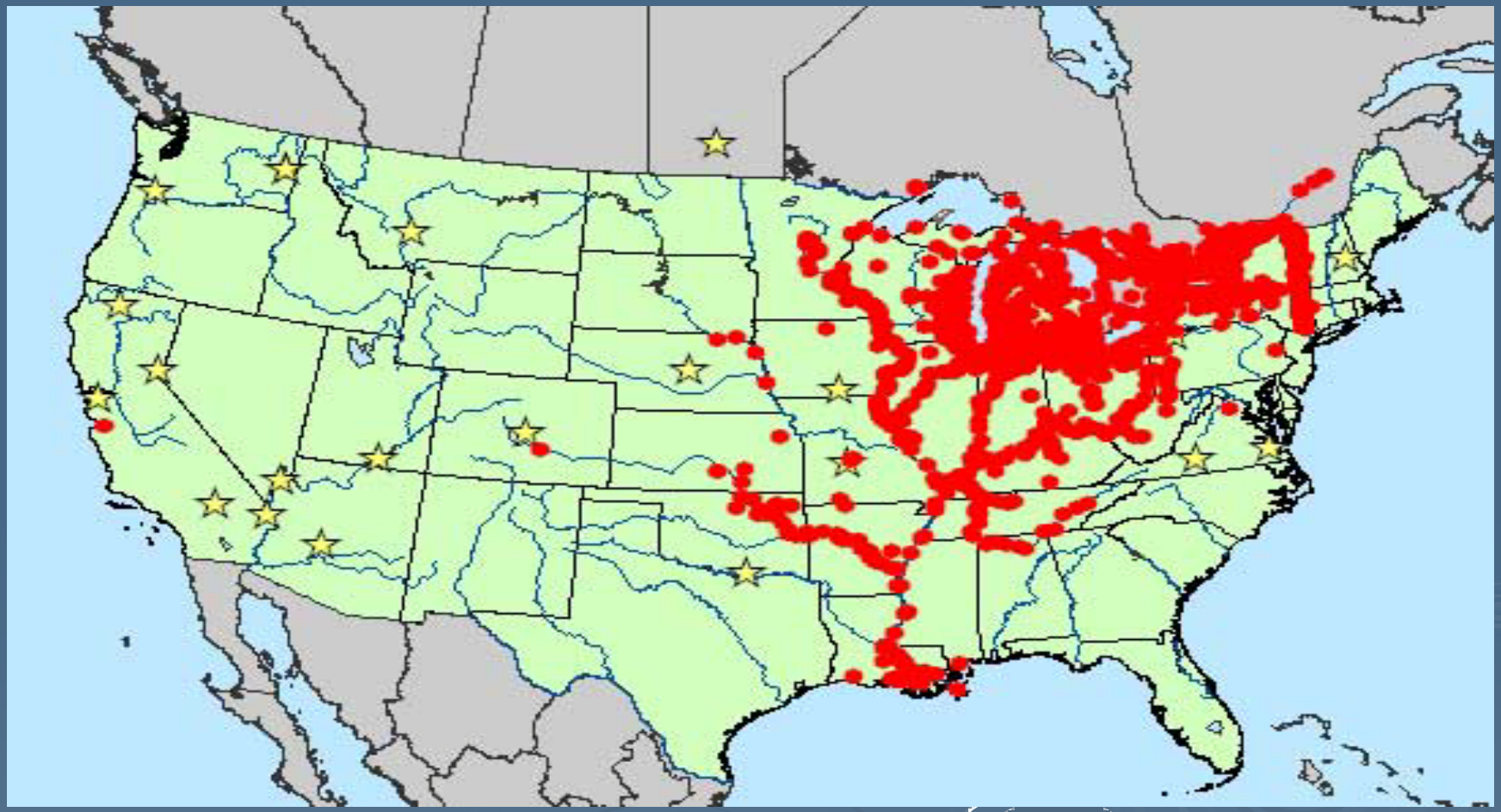
Zebra Mussel Distribution 2008



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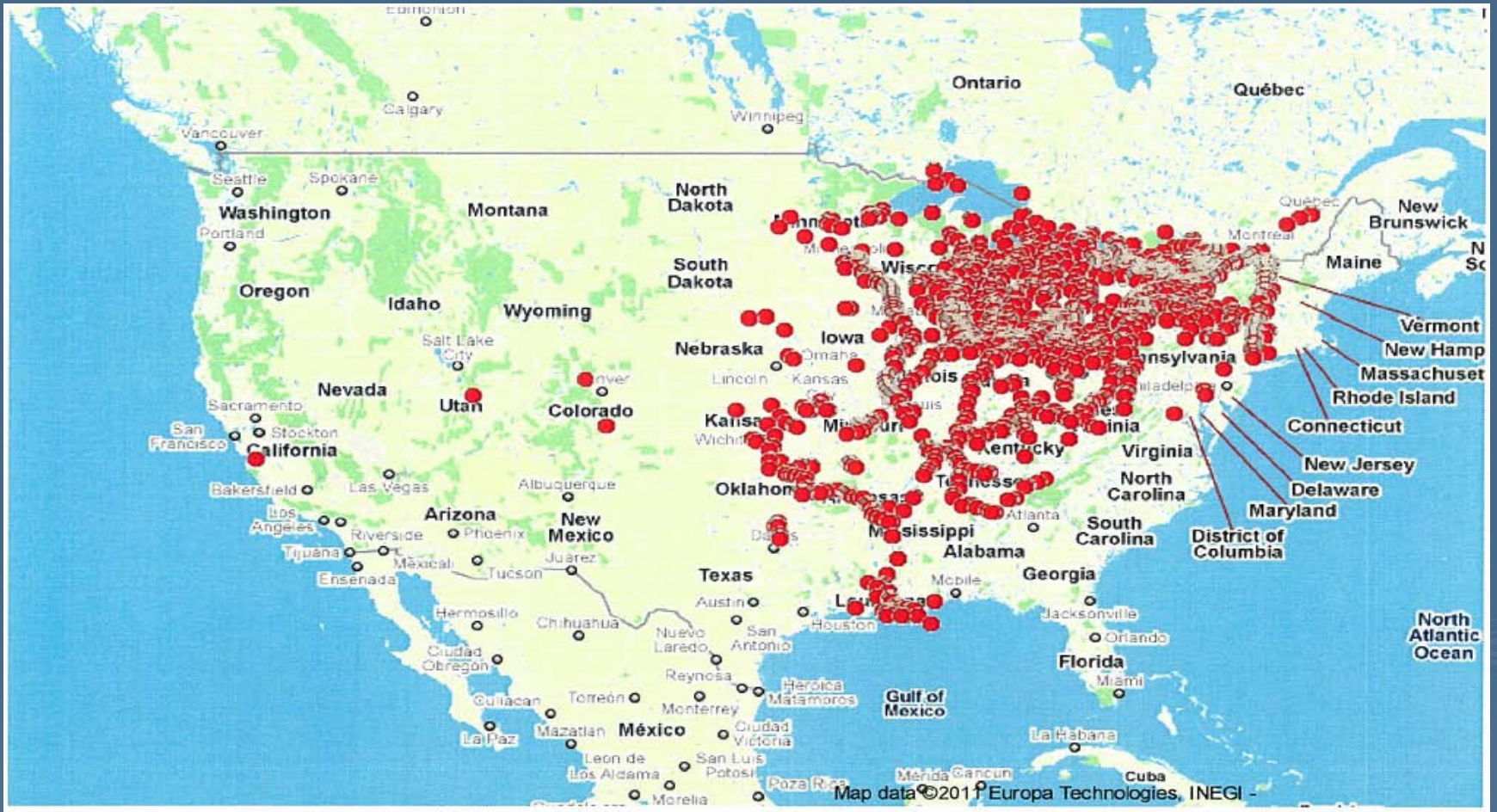
Zebra Mussel Distribution 2011



Suggested citation: Benson, A. J. 2011. Zebra mussel sightings distribution. Retrieved 4/12/2011 from

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Quagga Mussel Distribution 2009

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Quagga Mussel Distribution 2011

Suggested citation: Benson, A. J. 2011. Quagga mussel sightings distribution. Retrieved 4/12/2011 from

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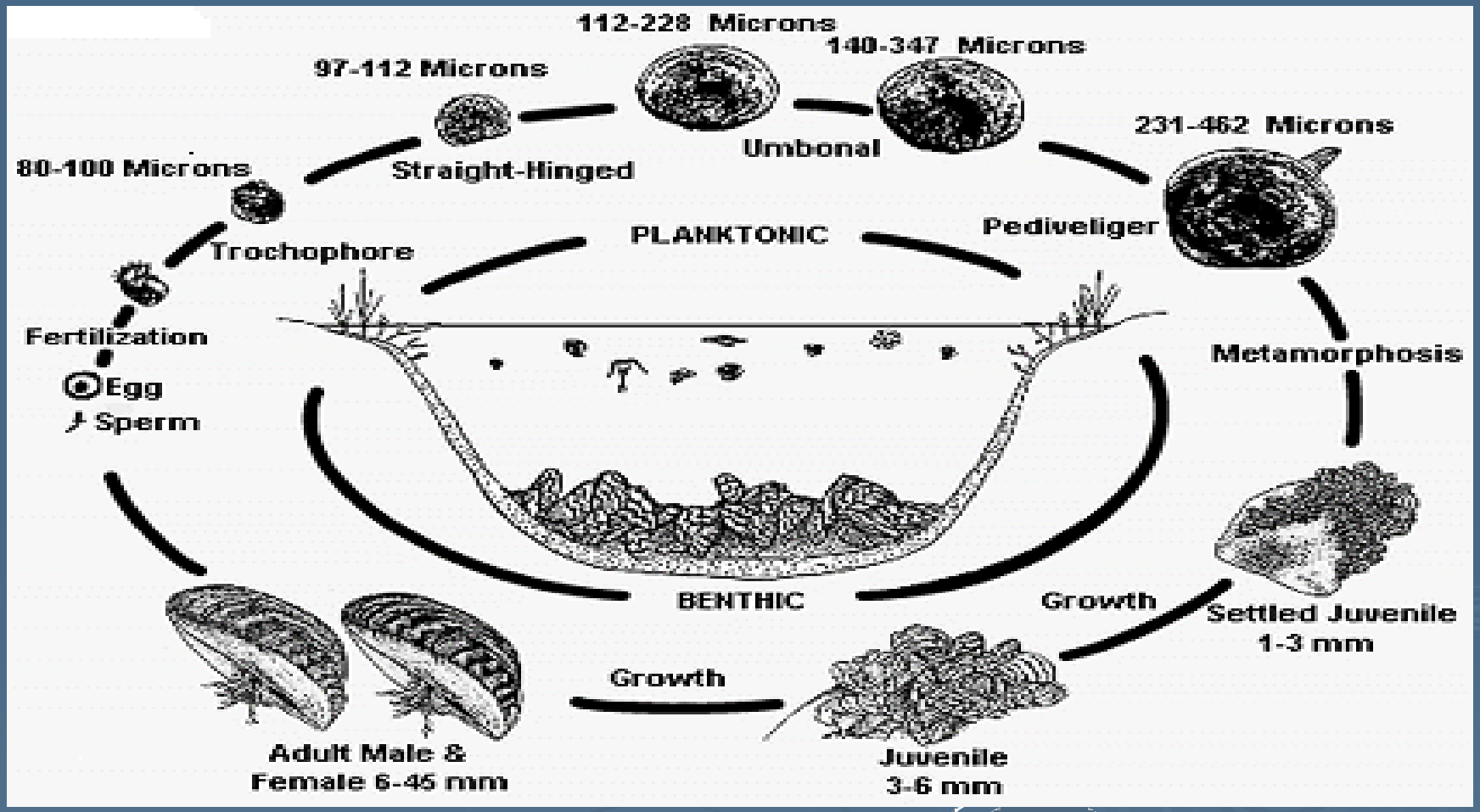
Some Basic Biology



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Environmental and Nutritional Requirements

- Gametes are released in the spring when water temperatures raise above 12°C.
- Planktonic gamete to settled juvenile takes 8 – 240 days.
- Minimum calcium concentration ~ 20 mg/L but “healthy” growth needs 40mg/L.
- Optimum pH range between 7 and 9.
- A minimum dissolved oxygen of 4.6 mg/L for growth – more is better.

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Why do we care?

- Zebra and Quagga mussels grow along and into the intakes and outlets of water system and power generation facilities.
- Significantly altered the Great Lakes ecosystem in the last 20 years.

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Control Measures

- Chlorine (Cl_2) 0.5 – 1.0 mg/L

Advantage - Kills the mussels and gives contact time.

Disadvantage – Its Chlorine gas, additional TTHM testing.

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Control Measures

- Bleach (NaClO) 0.5 to 1.0 mg/L

Advantages- Kills the mussels, relatively inexpensive and easy.

Disadvantages – More TTHM testing and it will cause feed lines to clog with calcium carbonate when the water is sufficiently alkaline.

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Control Measures

- Potassium Permanganate 0.5-0.75 mg/L

Advantages – Kills the mussels

Disadvantage – Its Potassium Permanganate

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Control Measures

- Chlorine Dioxide

Effective broad spectrum biocide.

Onsite generation is required due to its explosive nature.

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Control Measures

- Copper based coatings on intake barriers – cribs, screens, etc.

Mussels do not like the coatings.

Veligers will float past barriers and reside on interior uncoated surfaces. Not appropriate when salmonid fish species are present.

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Other Control Measures

- Electromagnetic fields
- Sonic waves
- Hot water (> 40°C)
- Desiccation
- Depletion of D.O. (close to 0 mg/L for effectiveness)
- Nutrient depletion
- Sparker Technology (Compression Waves)

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Environmental Issues

- Redistribution of nutrients and pollutants in the water and soils of a lake.
- Clarifies water in a lake allowing greater sunlight penetration.
- Increased algae blooms

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Environmental Issues
Related Pest(s)

- Round Goby

Came to Lake Erie in the early ’90s in ballast water. Native to the Caspian basin. Goby Feed on Mollusks.

- Cladophora

A green algae that grows to a high density in the clarified lake water then dies and mats on mussel beds.

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Environmental Issues
Related Pest(s)

- Clostridium Botulinum

An obligate anaerobe that grows in the anoxic cladophora mats on zebra mussel beds. Mussels die in the mats and Round Goby eat the mussels.

Goby are infected with the Clostridium and are eaten by the bass. Gobies and bass are eaten by shore birds and they all die.

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Environmental Issues

- Recent research indicates that warm water temperature is implicated in avian botulism outbreaks.
- Outbreaks coinsided with Round Goby populations.

* Links Between type E Botulism Outbreaks, Lake Levels, and Surface Water Temperatures in Lake Michigan, 1963-2008.

J. Great Lakes Research 37(1):86-91

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Geographical Distributions

- Zebra Mussels are found (mostly) in the Great Lakes and Mississippi River system.
- Quagga Mussels are more prevalent in the western states.
- Northwest waters seem to have been spared to date.
- Why?

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Availability of Calcium in the Water

- A calcium-based invasion risk assessment for zebra and quagga mussels (Dreissena spp)

  Front Ecol Environ 2008;6, doi:10.1890/070073

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Availability of Calcium in the Water

- Calcium Concentration data from 3,000 stream and river sites in contiguous United States.
- Defined Risk: Very low: < 12 mg/L

  Low: 12-20 mg/L

  Moderate 20-28 mg/L

  High > 28 mg/L

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Availability of Calcium in the Water

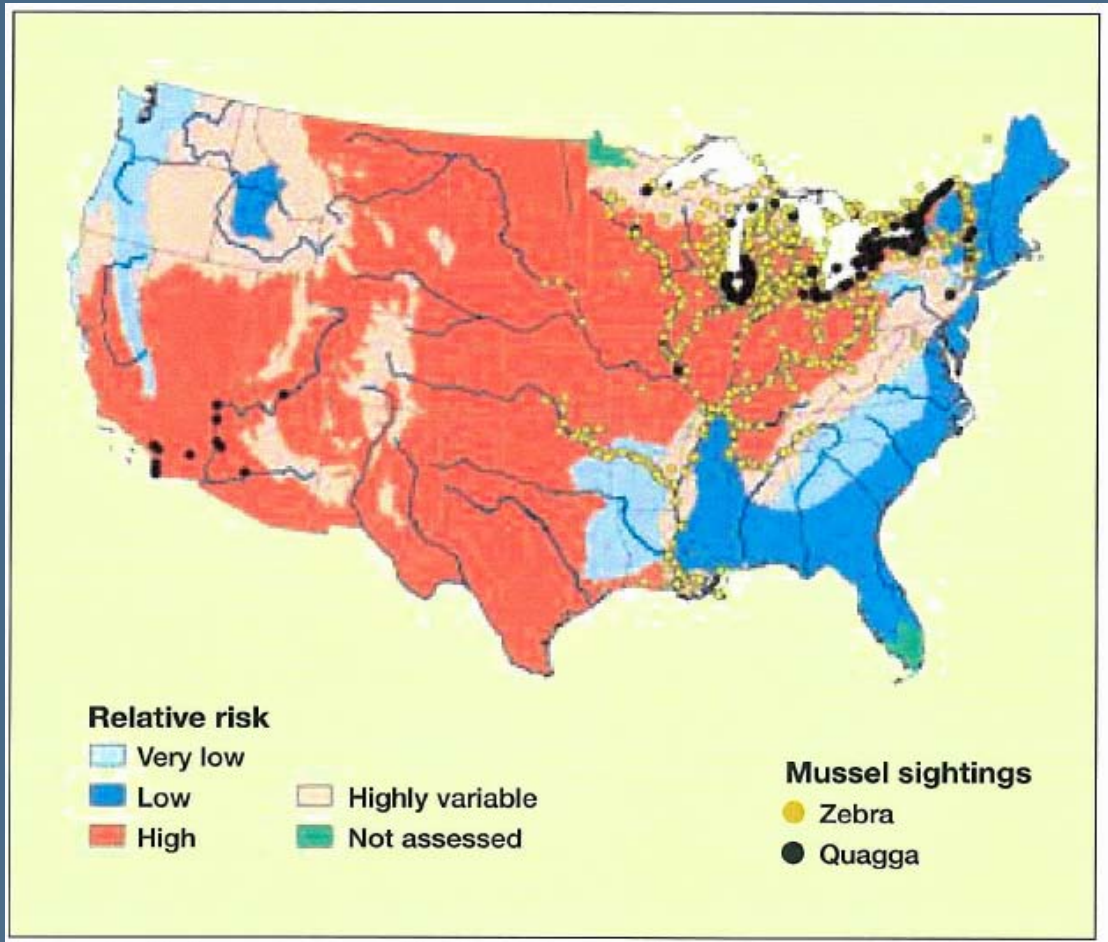

Figure 2. *Dreissena invasion risk classes for ecoregions of the contiguous US based on calcium concentrations in streams and rivers. Depending on watershed characteristics, some portions of the highly variable ecoregions will be at high risk, while others will be at very low risk. Dots indicate zebra mussel and quagga mussel observations through October 2007.*

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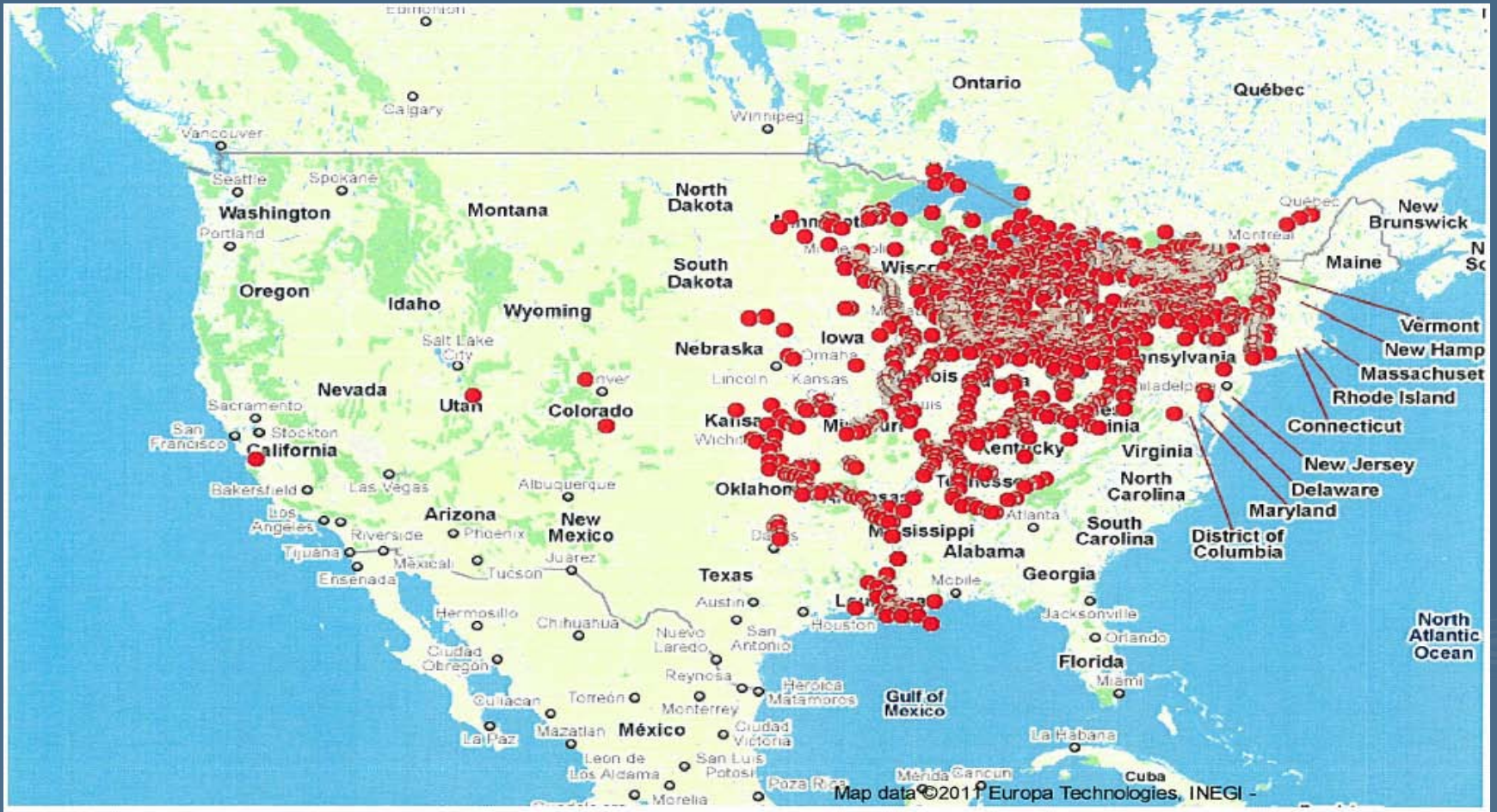
Zebra Mussel Distribution 2011



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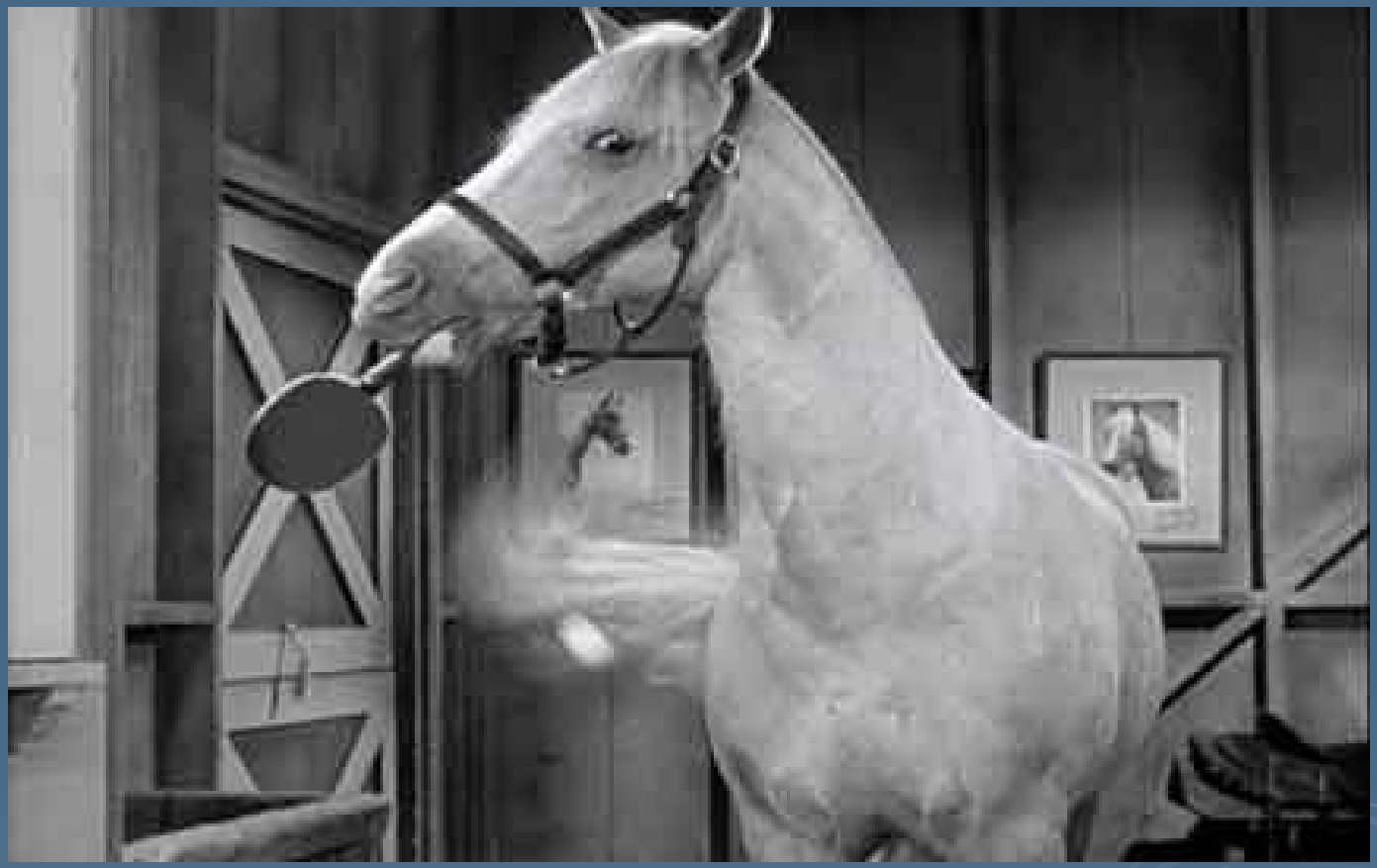
Questions and Discussion



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